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# The influence of the practice of physical activity on the quality of life, muscle strength, balance, and physical ability in the elderly

*A influência da prática de atividade física na qualidade de vida, força muscular, equilíbrio e capacidade física de idosos*

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## Abstract

**Introduction:** Ageing has become a huge public health challenge due to the need to find solutions for improving quality of life. **Objective:** This study aimed to assess quality of life, muscle strength, balance and physical capacity among elderly practitioners and non-practitioners of physical activity. **Materials and Methods:** An observational, cross-sectional study was carried out involving 74 elderly individuals in the city of Santos (state of São Paulo, Brazil), divided into two groups: practitioners and non-practitioners of physical activity. The International Physical Activity Questionnaire was used for the classification of the participants. The generic SF-36 questionnaire was used to assess quality of life. The Berg scale was used for the analysis of balance. Dynamometry was used for the muscle strength test. The six-minute walk test was used for the assessment of physical capacity. **Results:** Significant differences were found between elderly practitioners and non-practitioners of physical activity regarding quality of life ( $p = 0.001$ ), muscle strength ( $p = 0.001$ ), balance ( $p = 0.001$ ) and physical capacity ( $p = 0.001$ ). The data also showed that aspects of quality of life were strongly correlated with physical capacity among the non-practitioners of physical activity ( $r = 0.741$ ). **Conclusion:** Elderly individuals in the city of Santos (Brazil) who practice physical activity have better quality of life, muscle strength, physical capacity and balance in comparison to those who do not practice physical activity.

**Key words:** Aged. Motor Activity. Muscle Strength. Postural Balance. Physical Capacity. Quality of Life.

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## Resumo

**Introdução:** O envelhecimento torna-se um grande desafio para saúde pública, devido à necessidade de encontrar soluções para melhorar a qualidade de vida. **Objetivo:** O objetivo do presente estudo foi avaliar qualidade de vida, força muscular, equilíbrio e capacidade física de idosos praticantes e não-praticantes de atividade física. **Materiais e Métodos:** Foi realizado estudo observacional transversal com 74 idosos da cidade de Santos/SP- Brasil, divididos em dois grupos: praticantes e não-praticantes de atividade física. Para a coleta de dados, foi utilizado o questionário internacional de atividade física para a classificação dos idosos; para avaliar a qualidade de vida, o questionário genérico SF-36; a escala de Berg foi utilizada para análise do equilíbrio; para o teste de força muscular, empregou-se a dinamometria; e para a avaliação da capacidade física, utilizou-se o teste de caminhada de seis minutos. **Resultados:** Os dados do presente estudo mostram diferença significativa na qualidade de vida ( $p=0,001$ ), força muscular ( $p=0,001$ ), equilíbrio ( $p=0,001$ ) e capacidade física ( $p=0,001$ ) entre os idosos praticantes e não-praticantes de atividade física. Os dados demonstram também forte correlação na qualidade de vida e a capacidade física ( $r= 0,741$ ) no grupo não-praticantes de atividade física. **Conclusão:** Podemos concluir que os idosos da cidade de Santos que praticam atividade física têm melhor qualidade de vida, força muscular, capacidade física e equilíbrio do que os não praticam de atividade física.

**Palavras-chave:** Idoso.  
Atividade Motora. Força  
Muscular. Equilíbrio  
Postural. Capacidade Física.  
Qualidade de Vida.

## INTRODUCTION

The ageing process has increasingly been the focus of attention and concern due to the physical alterations that occur with age, such as reduced muscle strength and balance, as well as aspects related to quality of life.<sup>1-4</sup> Quality of life is defined as “the perception of individuals regarding their position in life in the context of culture and the value system in which they live, taking into account their goals, expectations, standards and concerns”.<sup>5</sup>

Physical activity is considered an important aspect for the maintenance of physical capacity, as it promotes improvements in balance and muscle strength.<sup>6</sup> A number of studies have related the practice of physical activity to improved quality of life,<sup>7</sup> muscle strength,<sup>8</sup> balance<sup>4</sup> and physical capacity.<sup>9</sup>

The IPAQ is an indicator of physical activity. According to the international physical activity questionnaire, can be classified as practitioners of physical activity those who exercised five times a week for 20 minutes/session of vigorous activity or any activity with (moderate + vigorous + walk) for 150 minutes per week. On the other hand, are classified as non-practitioners of physical

activity those who do no physical activity for at least 10 minutes continuously or exercise for at least 10 minutes per week, but not enough to be classified as active.<sup>10</sup>

According to the most recent data from the Brazilian Institute of Geography and Statistics, the city of Santos in the state of São Paulo (southeastern Brazil) is one of the cities in the country with the highest number of elderly inhabitants. Moreover, the quality of life of these individuals is considered high.

The aim of the present study was to assess quality of life, muscle strength, balance and physical capacity among elderly practitioners and non-practitioners of physical activity in the city of Santos, Brazil.

## MATERIALS AND METHODS

An observational, cross-sectional study was carried out involving elderly individuals in the city of Santos, state of São Paulo, Brazil. The subjects were the population of elderly in the city of Santos, where there are more than 65 thousand elderly, representing 15% of the total population of the city (IBGE, 2010).<sup>11</sup>

The sample was made up of male and female individuals aged 60 years or older, residents of the city of Santos (37 elderly practitioners of physical activity and 37 elderly non-practitioners of physical activity). Sample calculation was carried out using as variable, functional capacity, and quality of life questionnaire SF-36. From that estimate, physical activity participants were recruited in places where there are sports activities for the elderly population. The International Physical Activity Questionnaire was used for the division of the sample into practitioners and non-practitioners of physical activity.

This study was approved (CEP 0195/11, 25/02/11) by the Human Research Ethics Committee of the Universidade Federal de São Paulo (UNIFESP). The data was collected on a single day (duration: approximately 50 minutes). On average, four evaluations were performed – all by the main researcher. Recruitment of the volunteers was carried out using the UNIFESP press agency and through the UNIFESP extension project denominated “Walking with Seniors”.

The subjects were informed of the procedures, the voluntary nature, the possibility of leaving the study at any time and the confidentiality of the individual data. Those who agreed to participate signed a statement of informed consent. The inclusion criteria were age 60 years or older, living in the city of Santos and absence of a medical contraindication for physical activity. The exclusion criteria were any cognitive impairment that affected the subject's comprehension (determined using the Mini Mental State Exam [0 to 13 points]) and any symptomatic musculoskeletal condition. All individuals recruited met the inclusion criteria.

The following measures were employed

#### ***Mini Mental State Exam (MMSE)***

The aim of the MMSE is to screen for cognitive impairment. This test comprises five questions on temporal orientation (5 points), spatial orientation (5 points), registration (3 points), attention and calculation (5 points),

recall (3 points), language (8 points) and visual constructive capacity (1 point). The score ranges from 0 to 30 points, with higher scores denoting a greater degree of impairment.<sup>12</sup>

#### ***International Physical Activity Questionnaire (IPAQ short form)***

The International Physical Activity Questionnaire is made up of questions addressing activities performed in the previous week for at least ten minutes. The questionnaire classifies individuals as either active (practitioners of physical activity) or sedentary (non-practitioners of physical activity).<sup>10</sup> In the present study, practitioners were those who practiced physical activity five times a week for 20 minutes per session of vigorous activity or any summed activities (vigorous + moderate + walking) for 150 minutes a week. Non-practitioners were those who did not perform any physical activity for at least ten continuing minutes or performed physical activity for at least ten minutes a week but not at a sufficient level to be classified as active.

#### ***Generic quality of life assessment (SF-36)***

The Short Form Health Survey (SF-36) is composed of eight subscales (physical functioning, physical role functioning, bodily pain, general health perceptions, vitality, social role functioning, emotional role functioning and mental health). The score ranges from 0 to 100, with higher scores denoting better quality of life.<sup>13</sup>

#### ***Six-minute walk test (6”WT):***

The maximal distance traveled in six minutes was determined on a track measuring 24.7 meters. The participants walked with no assistance from the evaluator other than standardized vocal encouragement every two minutes (“Let’s go. You’re doing very well.”). The test was performed with the same evaluator and the time was determined using a chronometer.<sup>14</sup>

### *Balance assessment (Berg scale)*

The Berg Balance Scale was used for the assessment of balance. This scale is made up of 14 tasks. The ability to perform the tasks is scored on a five-point scale, ranging from 0 (inability) to 4 (secure and independent). The maximal score is 56 points, with higher scores denoting better balance.<sup>15</sup>

### *Maximal strength test*

A manual dynamometer (Lafayette, model 01163, USA) was used to assess isometric muscle strength. The test was performed twice with the dominant limb with a one-minute interval between tests and the mean of the two measurements was used for the statistical analysis. The volunteer first warmed up for one minute, performing flexion and extension of the knee. The volunteer was then seated on an examining table with the back supported and the knee at 90 degrees. The individual performed an isometric contraction of knee extension with the following command: "Make an effort as if you were going to kick me, "without moving your knee". The examiner applied manual resistance to the lower third of the leg (4 centimeters above the ankle) in the opposite direction of the movement until the dynamometer sounded (5 seconds).<sup>16</sup>

### *Statistical analysis*

Sample calculation: the sample size was calculated by defining a minimal significant difference of ten points on the Physical Functioning subscale of the SF-36. Based on information from the literature, a standard deviation of eight points was considered for both groups. With the level of significance set at 5% ( $p < 0.05$ ) and a 90% power, a minimum of 37 individuals for each group was determined.

Inferential statistical analysis: the results were expressed as mean and standard deviation values. Student's *t*-test for independent samples was used to compare groups with regard to the quantitative variables. Pearson's linear correlation coefficients were calculated to investigate associations between pairs of variables. The level of significance was set at 5% ( $p < 0.05$ ). Correlations were categorized as weak ( $r = 0$  to  $0.48$ ), moderate ( $r = 0.49$  to  $0.6$ ) or strong ( $r = 0.7$  to  $0.9$ ).

## RESULTS

Table 1 displays the data on age, gender and results of the MMSE, demonstrating that the groups were homogeneous with regard to these variables. Mean age was 68 years.

**Table 1** - Descriptive data (mean and standard deviation) on age, gender and results of MMSE according to group. Santos, SP, 2011.

	Practitioners of physical activity	Non-practitioners of physical activity
Age	68,08 $\pm$ 5,97	68,62 $\pm$ 6,72
Gender	M= 13 F= 24	M= 13 F= 24
MMSE	27,59 $\pm$ 1,86	28,00 $\pm$ 1,67

MMSE = Mini Mental State Exam; M = male; F = female;  $\pm$  = standard deviation.

Statistically significant differences between the practitioners and non-practitioners of physical activity were found for all subscales

of the SF-36 questionnaire, demonstrating that those who practiced physical activity had a better quality of life than non-practitioners (table 2).

**Table 2** - Comparison of practitioners and non-practitioners of physical activity regarding results of SF-36 quality of life questionnaire. Santos, SP, 2011

SF-36	Practitioners of physical activity	Non-practitioners of physical activity	Descriptive level
Physical functioning	97,84 $\pm$ 3,64	77,14 $\pm$ 22,23	p= 0,001
Physical role functioning	97,30 $\pm$ 16,44	60,81 $\pm$ 46,97	p= 0,001
Bodily pain	90,30 $\pm$ 15,97	63,97 $\pm$ 26,11	p= 0,001
General health state	94,86 $\pm$ 6,27	81,65 $\pm$ 14,84	p= 0,001
Vitality	89,05 $\pm$ 11,48	73,24 $\pm$ 16,55	p= 0,001
Social role functioning	98,99 $\pm$ 6,16	87,84 $\pm$ 22,34	p= 0,006
Emotional role functioning	99,10 $\pm$ 5,48	74,77 $\pm$ 43,32	p= 0,002
Mental health	90,38 $\pm$ 11,56	73,95 $\pm$ 17,04	p= 0,001

p = significance level;  $\pm$  = standard deviation.

Statistically significant differences between the practitioners and non-practitioners of physical activity were found regarding balance

(Berg scale), muscle strength (dynamometry) and physical capacity (6"WT) (table 3).

**Table 3** - Comparison of balance, muscle strength and physical capacity between practitioners and non-practitioners of physical activity. Santos, SP, 2011.

	Practitioners of physical activity	Non-practitioners of physical activity	Descriptive level
Berg	55,32 $\pm$ 1,51	51,22 $\pm$ 3,87	p= 0,001
Dynamometry (kg)	26,87 $\pm$ 9,08	17,96 $\pm$ 9,17	p= 0,001
6"WT	568,14 $\pm$ 84,22	416 $\pm$ 78,19	p= 0,001

6"WT = six-minute walk test;  $\pm$  = standard deviation; p = level of significance.

In the group of practitioners of physical activity, positive moderate correlations were found between vitality and the Berg scale ( $r = 0.499$ ), vitality and the 6''WT ( $r = 0.517$ ) and physical functioning and the 6''WT ( $r = 0.618$ ). In the group of non-practitioners of physical activity, a positive strong correlation

was found between physical functioning and the 6''WT ( $r = 0.741$ ) and positive moderate correlations were found between vitality and the Berg scale ( $r = 0.688$ ), physical role functioning and the Berg scale ( $r = 0.513$ ) and physical role functioning and the 6''WT ( $r = 0.513$ ) (table 4).

**Table 4** - Correlations between quality of life subscales and muscle strength, balance and physical capacity. Santos, SP, 2011.

	Practitioners of physical activity			Non-practitioners of physical activity		
	Dynamometry	Berg	6''WT	Dynamometry	Berg	6''WT
Vitality	* $r = 0,090$	** $r = 0,499$	** $r = 0,517$	* $r = 0,159$	** $r = 0,688$	* $r = 0,396$
Physical role functioning	* $r = 0,107$	* $r = 0,260$	* $r = 0,320$	* $r = 0,302$	** $r = 0,513$	** $r = 0,513$
General health state	* $r = 0,140$	* $r = 0,222$	* $r = 0,338$	* $r = 0,270$	* $r = 0,314$	* $r = 0,390$
Bodily pain	* $r = 0,020$	* $r = 0,278$	* $r = 0,386$	* $r = 0,276$	* $r = 0,450$	* $r = 0,388$
Physical functioning	* $r = -0,215$	* $r = 0,434$	** $r = 0,618$	* $r = 0,437$	** $r = 0,587$	*** $r = 0,741$

6''WT = six-minute walk test;  $r$  = level of correlation; \* weak correlation; \*\* moderate correlation; \*\*\* strong correlation.

## DISCUSSION

This study was carried out with male and female elderly individuals living in the city of Santos, which is considered one of the Brazilian cities with the best infrastructure for the elderly. The mean age of the participants was 68 years. The sample was characterized with regard to quality of life, muscle strength, physical capacity and balance and divided into two groups based on the degree of physical activity: practitioners and non-practitioners.

Statistically significant differences between the practitioners and non-practitioners of physical activity were found for all subscales of the SF36 questionnaire: physical functioning ( $p = 0.001$ ), physical role functioning ( $p = 0.001$ ), bodily pain ( $p = 0.001$ ), general health state ( $p = 0.001$ ), vitality ( $p = 0.001$ ), social role functioning ( $p = 0.006$ ), emotional role functioning ( $p =$

0.002) and mental health ( $p = 0.001$ ). These findings show that the practice of physical activity provides improvements in quality of life.

The results of the present study corroborated with studies of various authors,<sup>7,17-22</sup> which also found a relationship in aspects of quality of life through the practice of physical activity. This occurred because these studies have used quality-of-life questionnaire SF-36 as a method of evaluation of quality of life.

In a study involving 30 elderly individuals, the participants were divided into three groups. The first group was submitted to exercise once a week; the second was submitted to exercise twice a week and the third group was not submitted to any intervention (control group). The group that practiced exercise twice a week demonstrated an improvement in quality of life, as determined by the SF-36.<sup>23</sup>



In this study, statistically significant differences between practitioners and non-practitioners of physical activity were found regarding balance ( $p = 0.001$ ), muscle strength ( $p = 0.001$ ) and physical capacity ( $p = 0.001$ ), as determined using the Berg Balance Scale, dynamometry and the 6''WT, respectively. Previous studies addressing the effects of physical exercise on male and female elderly individuals divided into an intervention group and control group report a significant improvement in balance, as determined using the Berg Balance Scale, in the group having undergone the exercise protocol.<sup>4,24</sup> Other studies report improvements in muscle strength and balance in elderly individuals having undergone an exercise program.<sup>8,25</sup>

In a study carried out with 186 sedentary but healthy women between 60 and 83 years of age, the subjects were divided into three groups. The first group received instructions on physical activity to be performed at home with telephone support. The second group performed exercises (strength, resistance, flexibility and balance) supervised by a professional three times a week. The third group received no instructions and underwent no intervention. The women were re-evaluated after one year. The results demonstrated that the first group achieved an increase in muscle strength, whereas the second group demonstrated a better performance regarding functional capacity. The authors conclude that intervention is a valuable tool against inactivity.<sup>26</sup>

Another study evaluated 42 elderly practitioners of physical activity in two phases. The International Physical Activity Questionnaire was used to classify the participants as practitioners of physical activity; the Berg scale was used to assess balance and the 6''WT was used to assess physical capacity. A second evaluation was performed after a period of three years. The subjects had continued practicing physical activity. No significant difference was found with regard to balance, whereas there had been a reduction in physical capacity.<sup>27</sup> In a similar study, no significant difference was found in balance, whereas a significant improvement

in physical capacity had occurred ( $p = 0.001$ ).<sup>9</sup> These studies showed different results from those found in our studies in spite of using the same method of evaluation to assess the balance and the physical ability, perhaps this has occurred because of the sample studied.

Another study assessed 65 elderly individuals (mean age: 84 years) using dynamometry and the 6''WT pre and post-intervention and found a significant difference in muscle strength, but no difference in physical capacity.<sup>28</sup> In a study involving the assessment of balance (Berg scale) and physical capacity (Timed-Up-and-Go test) pre and post-intervention, elderly individuals were divided into two groups. The first underwent an intervention program based on balance and strength exercises and the second group was submitted to a program based on video games. The results showed significant improvements in both groups, but no significant difference was found in physical capacity following the intervention.<sup>29</sup> In this study were found similar results to those of our study for muscle strength tested by hand, but in relation to physical ability the results were different. This may be due to the stimulus as it may have been different.

In the group of practitioners of physical activity in the present study, moderate correlations were found between vitality and the Berg scale, physical role functioning and the Berg scale, vitality and the 6''WT and physical functioning and the 6''WT. In the group of non-practitioners of physical activity, a strong correlation was found between physical functioning and the 6''WT and moderate correlations were found between vitality and the Berg scale, physical role functioning and the Berg scale and physical role functioning and the 6''WT. Similar results are reported in a study carried out in Turkey, in which the authors assessed 100 elderly individuals aged 65 years or older and found strong correlation between functional capacity and quality of life.<sup>30</sup>

In a study involving an exercise program over a period of 12 months and assessments using the Berg scale and the SF-36 questionnaire,



improvements were found in balance ( $p = 0.015$ ) and quality of life ( $p = 0.031$ ), demonstrating that the practice of physical activity is correlated with quality of life.<sup>31</sup> Other authors report a strong positive correlation between muscle strength and physical capacity among elderly practitioners of physical activity.<sup>32,33</sup> A study involving 116 individuals aged 65 years or older found that improvements in balance and muscle strength were related to an improvement in quality of life.<sup>34</sup>

The above mentioned studies and the findings of this study show that improvements in muscle strength, balance and physical capacity are associated with the practice of physical activity. This evidence is of considerable importance, as the general population is ageing and measures are needed to address this ageing process and improve quality of life with regard to physical as well as social and mental aspects.

In spite of the sample that has been calculated, taking into consideration the Physical Functioning subscale of the SF-36 could have

increased the number of older people, but we would have difficulty to find non-physical activity practitioners who fulfill the inclusion criteria, given that we had not as a larger sample.

As the study was carried out in a city of southeastern Brazil, the sample number could have been larger, because the participants were people without symptomatic disease, but there was the difficulty of finding elderly not practicing physical activity. Therefore the sample was the minimum limit for which the work had a power appropriate and this was a limitation of the study.

## CONCLUSION

Based on the present findings, elderly individuals who practice physical activity have better quality of life than those who do not practice physical activity. The evidence demonstrates that quality of life is positively correlated with muscle strength, balance and physical capacity.

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